

Patent claims

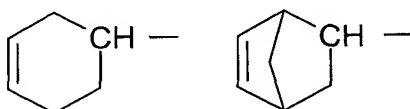
1. Hydrolyzable and polymerizable silanes of the general formula I

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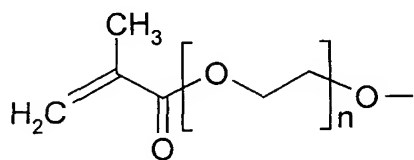
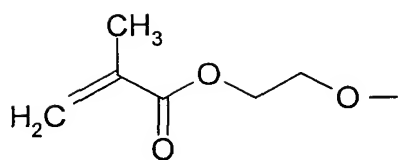
in which the radicals have the following meaning:

B = vinylcyclopropyl,



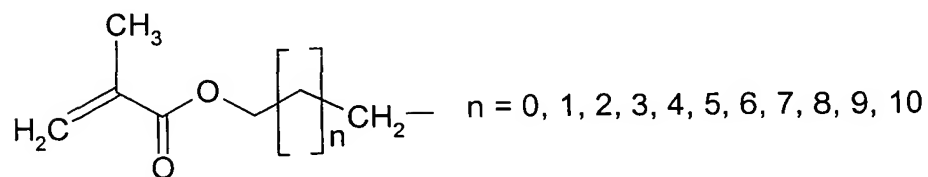
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or methacrylate radicals (including the corresponding acrylate radicals) from the following group:

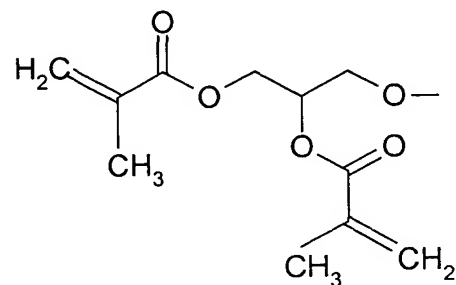


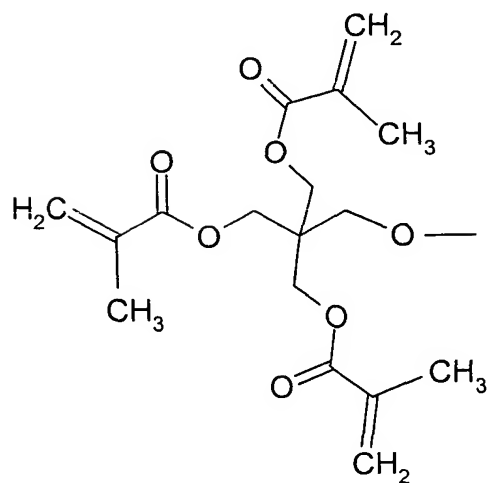
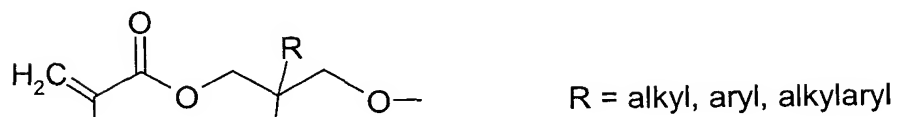
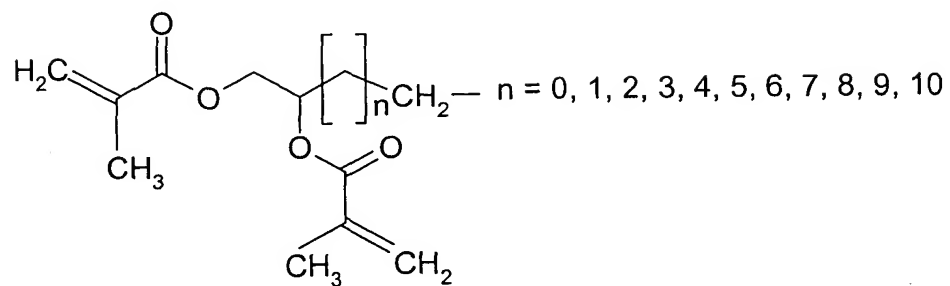
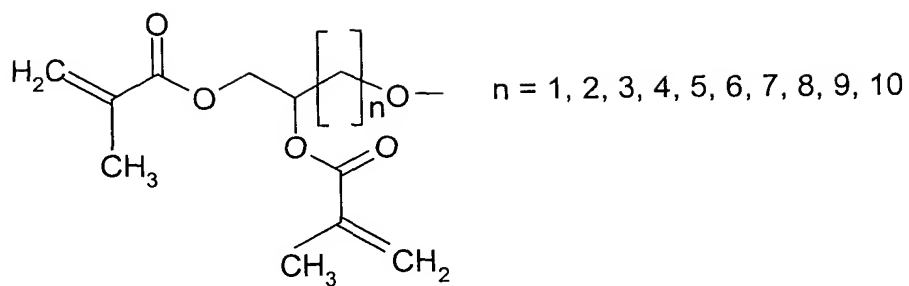
n=2,3,4,5,6,7, or mixtures with average n<10

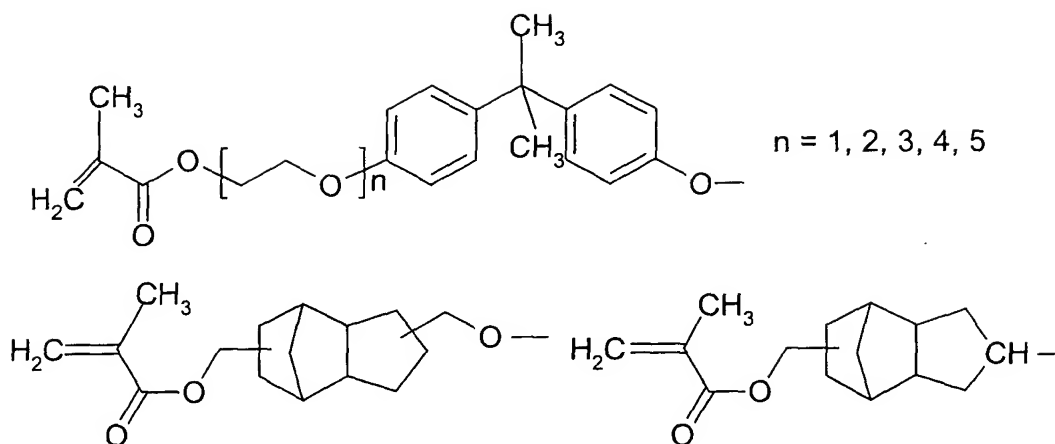
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n = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

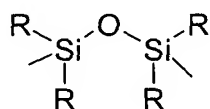




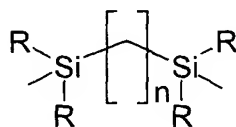


$\text{R}' =$  alkylene, alkenylene, arylene, arylenealkylene or  
 alkylenearylene in each case with 0 to 10 carbon atoms,  
 the radicals being able to be interrupted by oxygen and  
 sulphur atoms or by amino groups;

$\text{U} =$

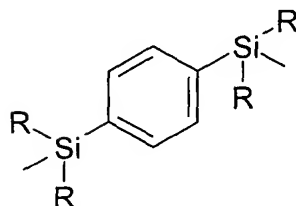


$\text{R} =$  alkyl, aryl, cycloalkyl

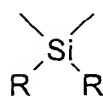


$\text{R} =$  alkyl, aryl, cycloalkyl

$n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10$



$\text{R} =$  alkyl, aryl, cycloalkyl



$\text{R} =$  alkyl, aryl, cycloalkyl

- D =  $-(CH_2)_n-Si(CH_3)_2(OC_2H_5)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)(OC_2H_5)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(OCH_3)_3$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(C_2H_5)_2(OCH_3)$ , with  $n = 0$  to  $10$   
 5  $-(CH_2)_n-Si(C_2H_5)(OCH_3)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(OC_2H_5)_3$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)_2(OCH_3)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)(OCH_3)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(C_2H_5)_2(OC_2H_5)$ , with  $n = 0$  to  $10$   
 10  $-(CH_2)_n-Si(C_2H_5)(OC_2H_5)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)(C_2H_5)(OCH_3)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)(C_2H_5)(OC_2H_5)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)(OC_2H_5)(OCH_3)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(C_2H_5)(OC_2H_5)(OCH_3)$ , with  $n = 0$  to  $10$   
 15  $-(CH_2)_n-Si(OC_2H_5)_2(OCH_3)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(OC_2H_5)(OCH_3)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)(OC(CH_3)=CH_2)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(C_2H_5)(OC(CH_3)=CH_2)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(CH_3)_2(OC(CH_3)=CH_2)$ , with  $n = 0$  to  $10$   
 20  $-(CH_2)_n-Si(C_2H_5)_2(OC(CH_3)=CH_2)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(OC_2H_5)(OC(CH_3)=CH_2)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(OC_2H_5)(OC(CH_3)=CH_2)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(OC_2H_5)_2(OC(CH_3)=CH_2)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(OC_2H_5)_2(OC(CH_3)=CH_2)$ , with  $n = 0$  to  $10$   
 25  $-(CH_2)_n-Si(C_6H_5)(OC_2H_5)_3$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(C_6H_5)(OCH_3)_2$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(C_6H_5)(OCH_3)(OC_2H_5)$ , with  $n = 0$  to  $10$   
 $-(CH_2)_n-Si(C_6H_5)(OC(CH_3)=CH_2)_2$ , with  $n = 0$  to  $10$ .

- 30 2. Silanes according to claim 1, characterized in that, in the general formula, the radical  $R^1$  has the following meaning:

R' = alkylene, alkenylene, arylene, arylenealkylene or alkylenearylene in each case with 0 to 5 carbon atoms, these radicals being able to be interrupted by oxygen and sulphur atoms or by amino groups.

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3. Process for the preparation of the silanes according to claim 1 or 2, characterized in that a dihydridosilicon compound is reacted in equimolar manner with an alkenyl silane compound which contains hydrolyzable groups, and the residual hydridosilyl group is reacted by renewed hydrosilylation with an at least twice-unsaturated organic compound.

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4. Use of the silanes according to claim 1 or 2 for the preparation of silicic acid polycondensates or of silicic acid heteropolycondensates by hydrolytic condensation of one or more hydrolytically condensable compounds of silicon and optionally other elements from the group B, Al, P, Sn, Pb, the transition metals, the lanthanides and the actinides, and/or precondensates derived from the above-named compounds, optionally in the presence of a catalyst and/or a solvent, by the action of water or moisture, characterized in that 5 to 100 mol-% based on monomeric compounds of the hydrolytically condensable compounds are selected from silanes of the general formula I:

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in which the radicals are as defined in claim 1.

5. Use according to claim 4, characterized in that compounds which can be radically or ionically polymerized are used, optionally in precondensed form, as further hydrolytically condensable compounds.

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6. Use according to claim 4 or 5, characterized in that one or more compounds of the general formula VI are used, optionally in

Sub A3

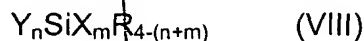
precondensed form, as further hydrolytically condensable compounds of silicon:



in which the radicals and indices have the following meaning:

- X = hydrogen, halogen, hydroxy, alkoxy, acyloxy, alkylcarbonyl, alkoxycarbonyl or  $NR''_2$ ;
- R = alkyl, alkenyl, aryl, alkylaryl or arylalkyl;
- R'' = hydrogen, alkyl or aryl;
- $R^{10}$  = alkylene or alkenylene, these radicals being able to be interrupted by oxygen or sulphur atoms or  $-NH$  groups;
- Z' = halogen or an optionally substituted amino, amide, aldehyde, alkylcarbonyl, carboxy, mercapto, cyano, alkoxy, alkoxycarbonyl, sulfonic acid, phosphoric acid, acryloxy, methacryloxy, epoxy or vinyl group;
- e = 0,1,2 or 3;
- f = 0,1,2 or 3, with  $e + f = 1,2$  or 3.

7. Use according to one of claims 4 to 6, characterized in that one or more compounds of the general formula VIII are used, optionally in precondensed form, as further hydrolytically condensable compounds of silicon:



in which the radicals X and R have the meaning given in claim 6 and the other radicals and indices have the following meaning:

- Y = a substituent which contains a substituted or unsubstituted 1,4,6-trioxaspiro-[4,4]-nonane radical;
- n = 1,2 or 3;

$m = 1, 2 \text{ or } 3, \text{ with } n + m \leq 4.$

8. Use according to one of claims 4 to 7, characterized in that one or more aluminium, titanium or zirconium compounds, soluble in the reaction medium, of the formula:



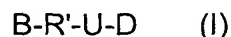
are used, optionally in precondensed form, as further hydrolytically condensable components, in which M stands for titanium or zirconium, the radicals R,  $\text{R}^0$  and X are the same or different,  $\text{R}^0$  represents halogen, hydroxy, alkoxy or acyloxy, y is an integer from 1 to 4, in particular 2 to 4, z stands for 0, 1, 2 or 3, preferably for 0, 1 or 2 and X and R are as defined in claim 6.

9. Use according to one or more of claims 4 to 8, characterized in that one or more initiators are added to the polycondensate, and the polycondensate cures thermally, photochemically, in covalent-nucleophilic manner or by redox-induction.

10. Use according to one or more of claims 4 to 8, characterized in that one or more radically and/or ionically polymerizable components are added to the polycondensate before polymerization.

11. Use of the silanes according to claim 1 for the preparation of polymerisates by radical polymerization of compounds containing one or more C=C double bonds and optionally other radically polymerizable compounds and optionally by ionic polymerization of one or more ionically polymerizable compounds, by the action of heat and/or electromagnetic radiation and/or by redox-induction and/or in covalent-nucleophilic manner, optionally in the presence of one or more initiators and/or a solvent, characterized in that 5 to 100 mol-%

based on monomeric compounds are selected from silanes of formula I:

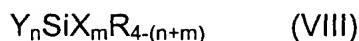


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in which the radicals are as defined in claim 1 or 2.

12. Use according to claim 11, characterized in that one or more silanes of the general formula VIII are used as cationically polymerizable compounds:

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in which the radicals and indices are as defined in claim 7.

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13. Use according to one or more of claims 11 to 12, characterized in that the polymerisate is hydrolytically condensed, optionally in the presence of further, hydrolytically condensable compounds of silicon and optionally other elements from the group B, Al, Sn, Pb, the transition metals, the lanthanides and the actinides, and/or precondensates derived from the above-named compounds by the action of water or moisture, optionally in the presence of a catalyst and/or a solvent.

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14. Use according to claim 13, characterized in that one or more compounds of the general formula VI are used, optionally in precondensed form, as further condensable compounds of silicon:

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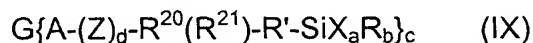


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in which the radicals and indices are as defined in claim 6.



15. Use according to one of claims 4 to 10, characterized in that one or more compounds of the general formula IX are used, optionally in precondensed form, as further condensable compounds of silicon:



in which the radicals and indices have the following meaning:

- X = hydrogen, halogen, hydroxy, alkoxy, acyloxy, alkylcarbonyl, alkoxycarbonyl or  $NR''_2$ ;
- R = alkyl, alkenyl, aryl, alkylaryl or arylalkyl;
- R' = alkylene, alkenylene, arylene, arylenealkylene or alkylenearylene in each case with 0 to 10 carbon atoms, these radicals being able to be interrupted by oxygen and sulphur atoms or by amino groups;
- R'' = hydrogen, alkyl or aryl;
- G = a straight-chained or branched organic radical with at least one C=C double bond and 4 to 50 carbon atoms;
- A = O, S or NH for  $d = 1$  and
- Z = CO and
- $R^{20}$  = alkylene, arylene or alkylenearylene in each case with 1 to 10 carbon atoms, these radicals being able to be interrupted by oxygen and sulphur atoms or by amino groups, and
- $R^{21}$  = COOH;

or

- A = O, S or NH for  $d = 1$  and
- Z = CO and
- $R^{20}$  = alkylene, arylene or alkylenearylene in each case with 1 to 10 carbon atoms, these radicals being

able to be interrupted by oxygen and sulphur atoms or by amino groups, and

$R^{21} = H;$

5 or

$A = O, S, NH$  or  $COO$  for  $d = 1$  and

$Z = CHR$ , with  $R$  equal to  $H$ , alkyl, aryl or alkylaryl, and

$R^{20} =$  alkylene, arylene or alkylenearylene in each case with 1 to 10 carbon atoms, these radicals being able to be interrupted by oxygen and sulphur atoms or by amino groups, and

10

$R^{21} = OH;$

15 or

$A = O, S, NH$  or  $COO$  for  $d = 0$  and

$R^{20} =$  alkylene, arylene or alkylenearylene in each case with 1 to 10 carbon atoms, these radicals being able to be interrupted by oxygen and sulphur atoms or by amino groups, and

20

$R^{21} = OH;$

or

25

$A = S$  for  $d = 1$  and

$Z = CO$  and

$R^{20} = N$  and

$R^{21} = H;$

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$a = 1, 2$  or  $3;$

$b = 0, 1$  or  $2;$

$a+b = 3;$

c = 1,2,3 or 4;  
d = 0 or 1.

- 5 16. Use of the silanes according to claim 1 or 2 in the dental field for the preparation of filling materials, cements, temporary crown and bridge materials, facing materials, lacquers, sealers, adhesion promoters, primers and bondings.

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